WHAT IS CLAIMED IS:

1. A method of embedding digital watermark information in a color image, said method comprising the steps of:

5   providing a color signal transformation matrix and an inverse color signal transformation matrix, the color signal transformation matrix transforming image data in a first colorimetric system, which expresses a predetermined color space by a combination of plural parameters, into image data in a second colorimetric system, which

10   expresses the predetermined color space by a combination of other plural parameters, the inverse color signal transformation matrix carrying out inverse of the transformation;

adjusting the color signal transformation matrix by either of adding and subtracting a digital watermark matrix to and from

15   the color signal transformation matrix, the digital watermark matrix including an arbitrary numerical value of real number x, which represents the digital watermark information, as an entry thereof and satisfying a condition that a sum of respective entries in each row and in each column is all substantially equal to zero;

20   transforming the image data in the first colorimetric system into image data in the second colorimetric system with the adjusted color signal transformation matrix; and

inversely transforming the resulting image data in the second colorimetric system, which is obtained by the transformation, into

25   the image data in the first colorimetric system with the inverse color signal transformation matrix, so as to embed the digital

28

watermark information into the color image.

2. An embedding method in accordance with claim 1, wherein one of the first colorimetric system and the second colorimetric

5   system is an RGB colorimetric system using three primary colors of light as parameters, and the other of the first colorimetric system and the second colorimetric system is a YCbCr colorimetric system using a luminance signal and color difference signals as parameters.

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3. An embedding method in accordance with claim 1, wherein the arbitrary numerical value of real number x is an arbitrary value in a range of not less than -0.1 and not greater than 0.1.

15   4. An embedding method in accordance with claim 2, said method further comprising the step of:

carrying out either one of underflow correction and overflow correction to cause an arbitrary pixel value to be an integer within a predetermined range in the process of inversely transforming the

20   image data in the YCbCr colorimetric system, which is obtained by the transformation with the adjusted color signal transformation matrix, into the image data in the RGB colorimetric system by means of the inverse color signal transformation matrix.

25   5. A decoding method to take a digital watermark out of image data with the digital watermark embedded therein, said method

comprising the steps of:

calculating a difference matrix between watermark-embedded data, which is obtained by transforming a color image with a digital watermark embedded therein into color signals in a YCbCr

5   colorimetric system, that is, a luminance signal and color difference signals, and watermark-free data, which is obtained by transforming an original image without the digital watermark embedded therein into color signals in the YCbCr colorimetric system, that is, a luminance signal and color difference signals;

10   decomposing the difference matrix into respective rows and calculating an arbitrary numerical value of real number x, which is supposed to represent the digital watermark information, with regard to each row; and

estimating a mean of the numerical values of real number x

15   calculated with regard to the respective rows as the digital watermark information.

6. A decoding method in accordance with claim 5, wherein the arbitrary numerical value of real number x, which is supposed to

20   represent the digital watermark information, is calculated on the premise that an absolute value of a difference between entries in each row of the difference matrix is not less than a preset value.

7. A storage medium in which a program for embedding digital

25   watermark information in a color image is stored in a computer readable manner, said program comprising:

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a color signal transformation matrix that transforms image data in a first colorimetric system, which expresses a predetermined color space by a combination of plural parameters, into image data in a second colorimetric system, which expresses the predetermined

5 color space by a combination of other plural parameters, and an inverse color signal transformation matrix that carries out inverse of the transformation;

the function of adjusting the color signal transformation matrix by either of adding and subtracting a digital watermark matrix

10 to and from the color signal transformation matrix, the digital watermark matrix including an arbitrary numerical value of real number x, which represents the digital watermark information, as an entry thereof and satisfying a condition that a sum of respective entries in each row and in each column is all substantially equal

15 to zero;

the function of transforming the image data in the first colorimetric system into image data in the second colorimetric system with the adjusted color signal transformation matrix; and

the function of inversely transforming the resulting image

20 data in the second colorimetric system, which is obtained by the transformation, into the image data in the first colorimetric system with the inverse color signal transformation matrix, so as to embed the digital watermark information into the color image.

25 8. A storage medium in which a program for taking a digital watermark out of image data with the digital watermark embedded

31

therein is stored in a computer readable manner, said program comprising the functions of:

calculating a difference matrix between watermark-embedded data, which is obtained by transforming a color image with a digital watermark embedded therein into color signals in a YCbCr colorimetric system, that is, a luminance signal and color difference signals, and watermark-free data, which is obtained by transforming an original image without the digital watermark embedded therein into color signals in the YCbCr colorimetric system, that is, a luminance signal and color difference signals;

decomposing the difference matrix into respective rows and calculating an arbitrary numerical value of real number x, which is supposed to represent the digital watermark information, with regard to each row; and

estimating a mean of the numerical values of real number x calculated with regard to the respective rows as the digital watermark information.

32